Testing of an F/A-18 Automatic Carrier Landing System Using Shipboard Relative GPS

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Overview

- JPALS Program
- System Description
- Development and Build-Up Testing
- Shipboard Testing
- Flight Test Results

Joint Precision Approach and Landing System (JPALS)

Ground Systems

Civil/International

Civil C/A-Code

Fixed Base

Military
P(Y)-Code
GPS

Tactical/Spec Msn

P(Y)- Code
Anti-Jam
Portable

Shipboard

P(Y) Code
Kinematics
Anti-Jam

VHF

VHF

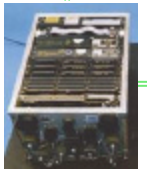
VHF

UHF

Data Link

Antenna

GPS

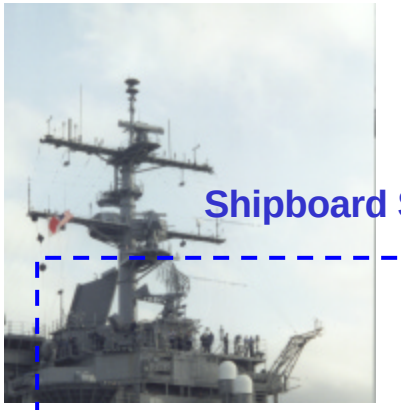


Display

Mission Computer

Airborne Equipment

SRGPS Hardware Diagram



Naval Avionics Platform Integration Emulator (NAPIE)

- Allows production aircraft to be used as a flying avionics test bed with minimal modifications and without changes to aircraft operational flight programs (OFP) or avionics
- Use existing aircraft systems and displays where possible
- System can be isolated from the aircraft via bus relays (Isolate/Operate Switch)

SRGPS Cockpit Display/Functions

Push to Couple A/P

Select SRGPS Approach

Select SRGPS TACAN Guidance

Autopilot Coupled to SRGPS

GPS DME

Guidance Display

Key Test Tools Used

- Ability to replay collected raw sensor data through algorithms (For System Optimization)
- Quick upload of new software (incl. NAPIE Display Changes)
- Real-time download of critical performance parameters
- Quick Look Data Reports
  - Sensor
  - KCPT
  - Guidance and Control
  - Time Space Position Information (TSPI)

Van Testing

- Van testing was used to verify system design between two moving platforms
- Benefits:
  - Van was more available and accessible than the aircraft
  - Build confidence in system design prior to aircraft integration
  - Risk mitigation
  - Significant cost savings in preliminary testing

On Aircraft Ground Testing

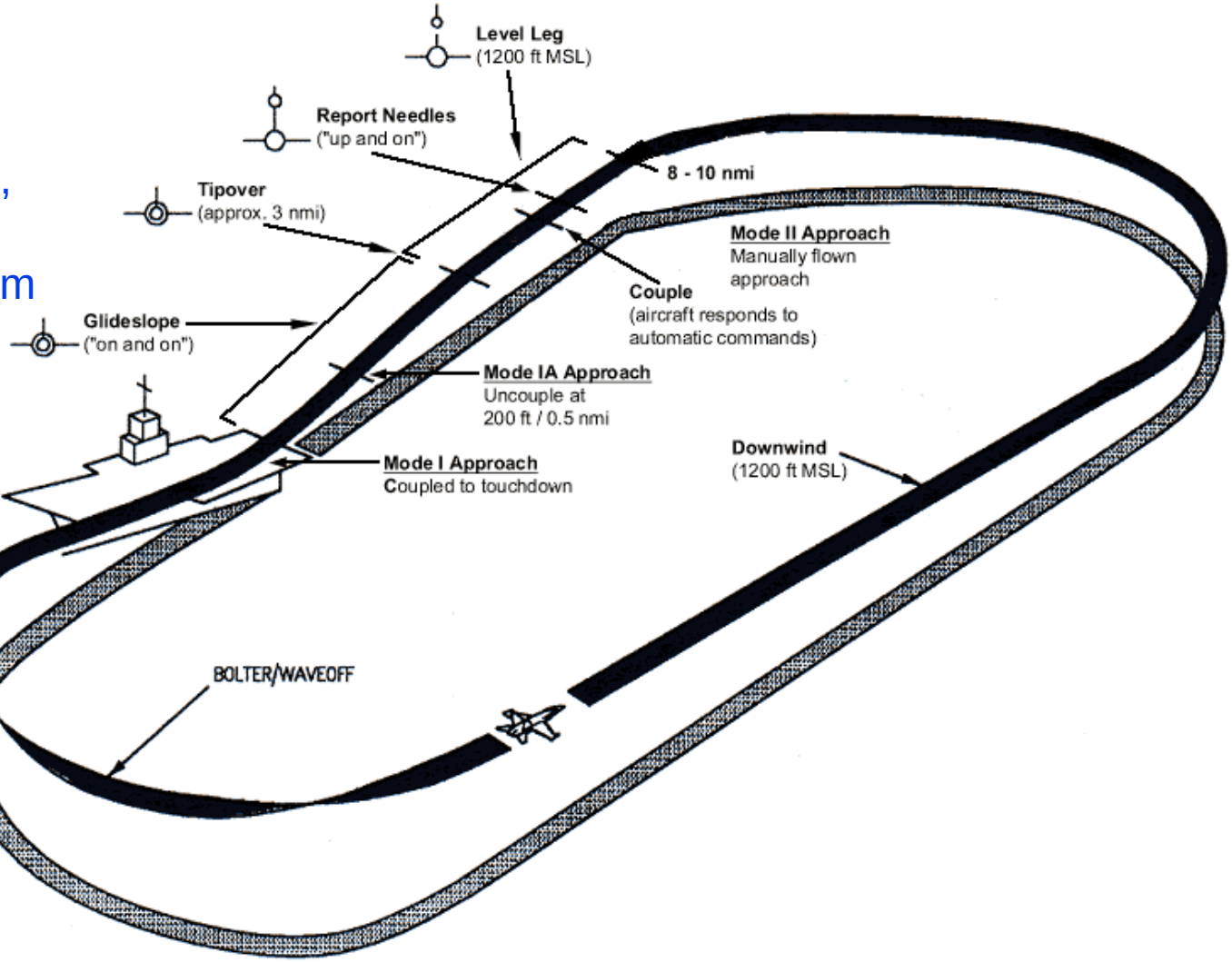
- Ground testing using actual aircraft and system hardware allowed for quick verification of changes made during development
- Use of a GPS simulator allowed repeatable controlled scenarios
- Testing in the hangar allowed for rapid development regardless of weather

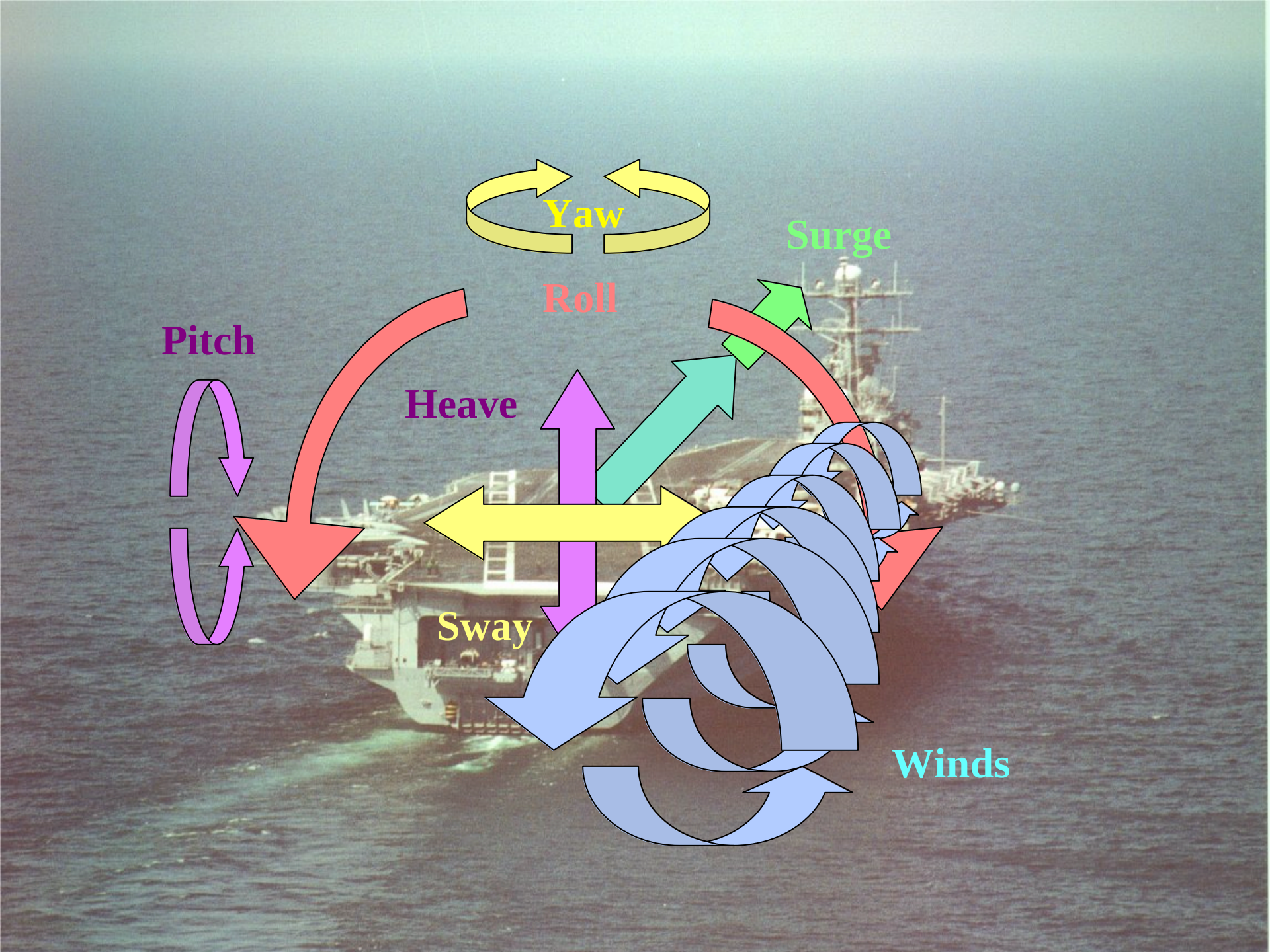
Shore Based Build-Up Testing

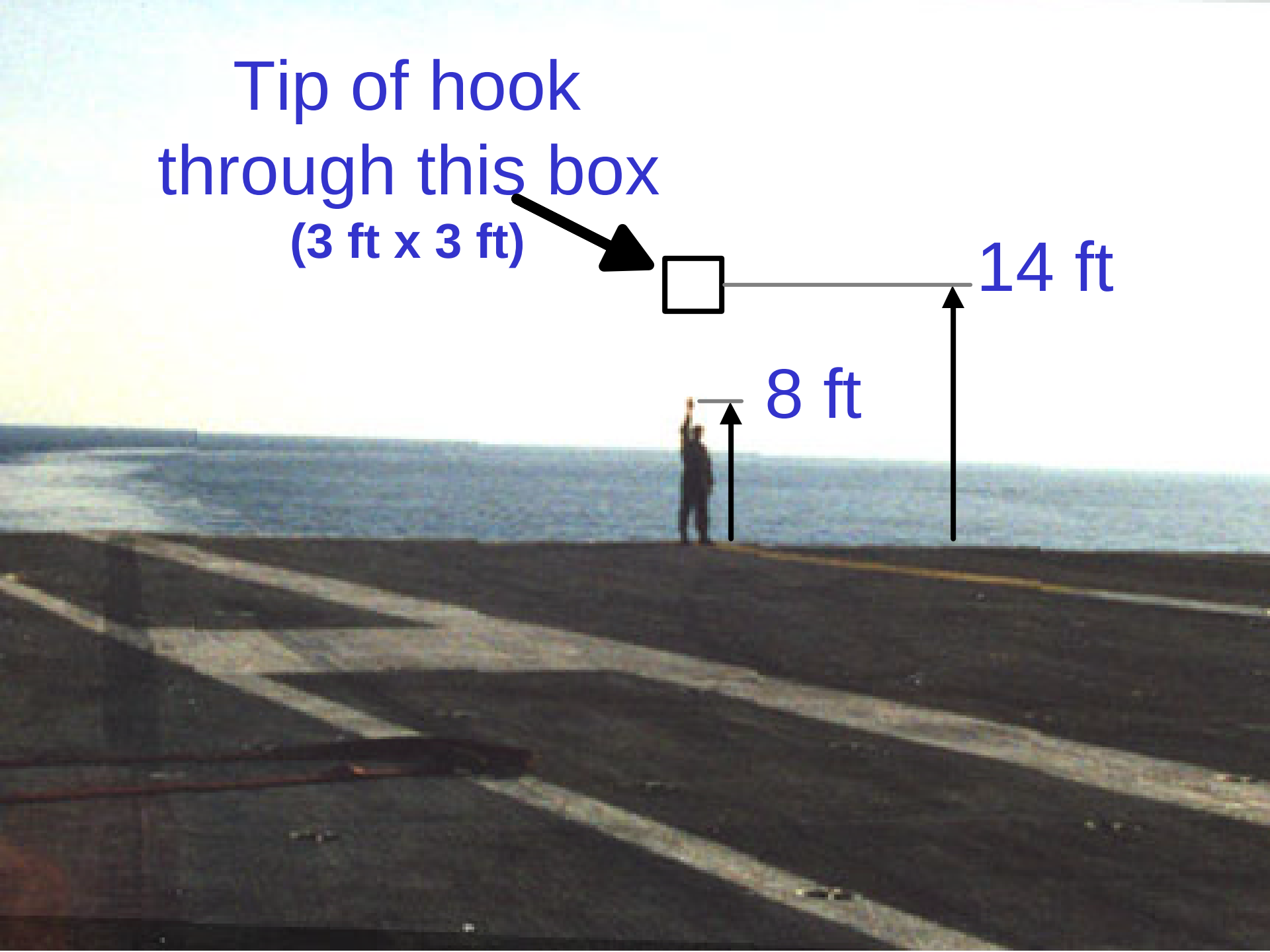
- Build-up confidence in system performance prior to shipboard testing
- Final stages of system development and performance optimization

Shipboard Approaches

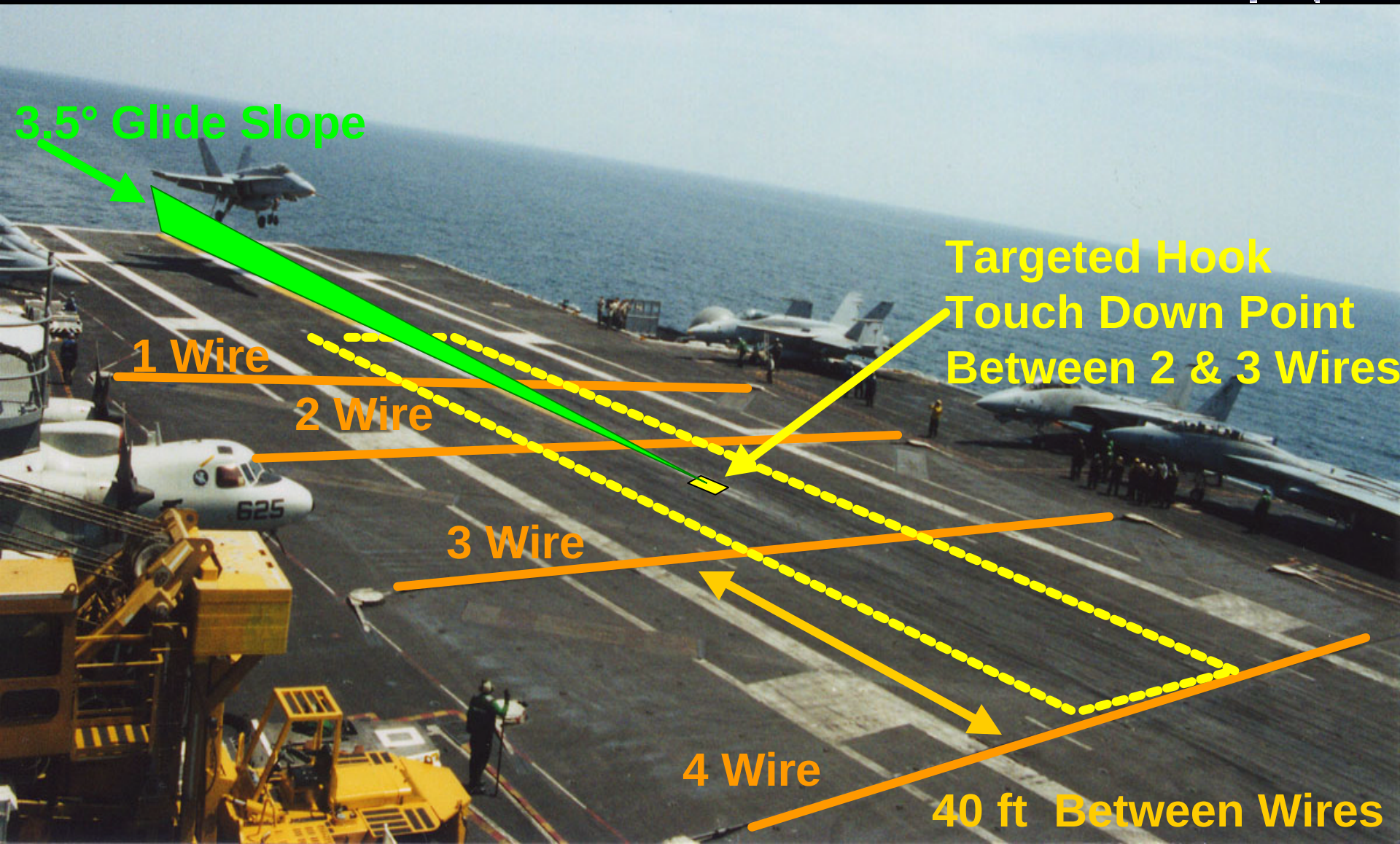
- Manual Approach, Manual Landing (Mode II)
- Automatic Approach, Manual Landing from 200ft and 0.5 nm (Mode IA)
- Automatic Approach Automatic Landing (Mode I)




Yaw
Surge
Roll
Pitch
Heave
Sway
Winds


Tip of hook
through this box
(3 ft x 3 ft)
14 ft
8 ft

Carrier Deck Landing Area



Shipboard Installation

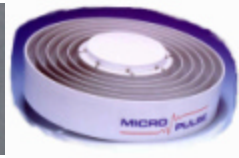
Shipboard System (SPN-43 rm)

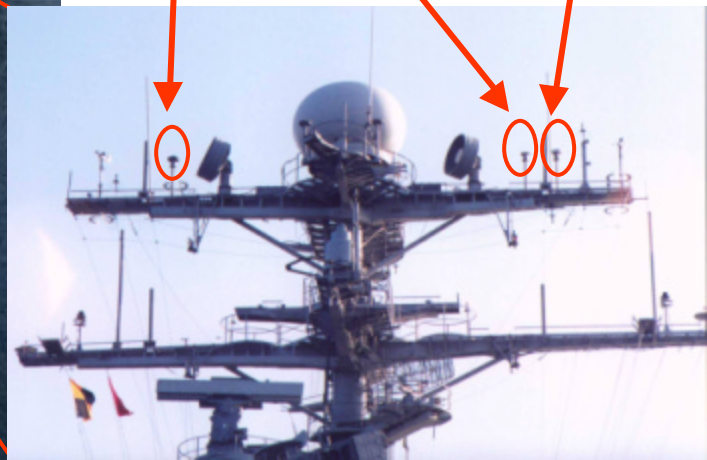
Real Time Display
(SPN-46 rm)

Yardarm FRPA Antennas

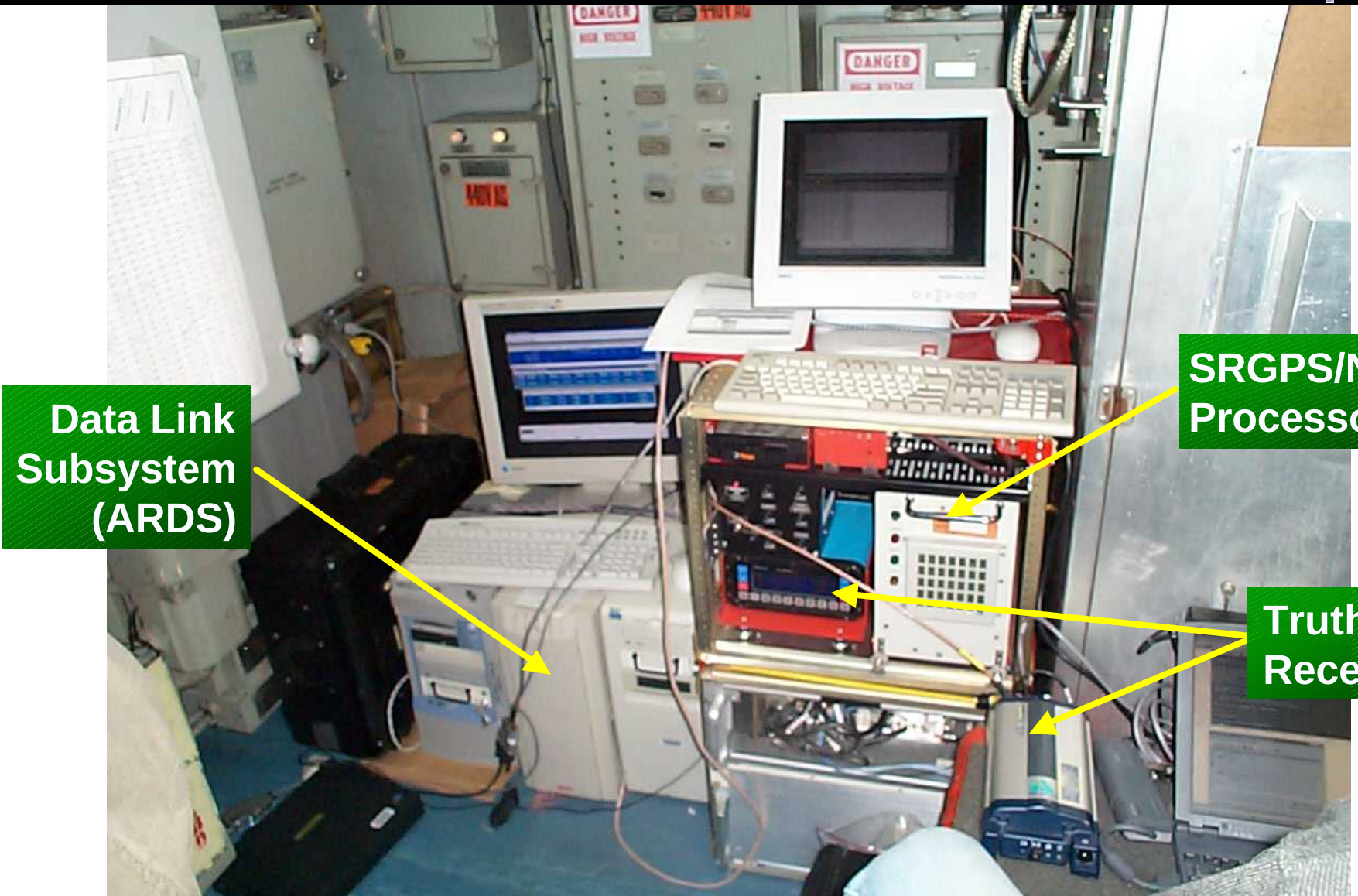
1) Starboard - Shipboard FRPA
2) Inner Port - FRPA
3) Outer Port - Choke Ring FRPA

1) 2) 3)





Shipboard System



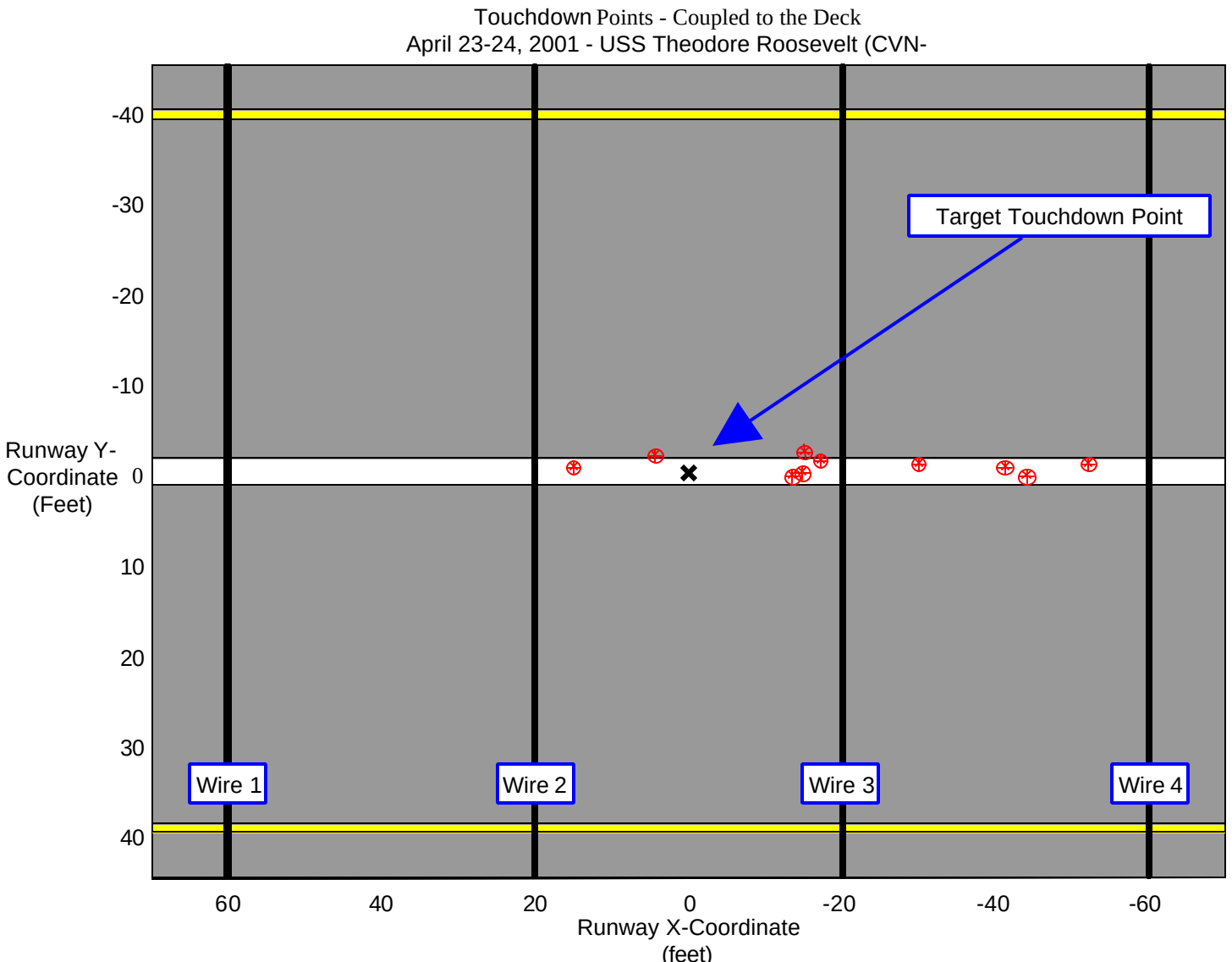
Shipboard Flight Testing
USS. Theodore Roosevelt

- Shipboard Flight Testing April 20 - 24, 2001
  - 10 Mode I's (Auto Landing)
  - 24 Elevated TDP Mode I's and IA's (100-400 ft)
  - 6 Mode II's (Manual Control)

- Total of 6.6 hours of Shipboard Flight Testing

- Demonstrated feasibility of SRGPS in the shipboard operational environment

Visual View of Hook Touchdown



Questions?